CINEFORUM
ISSN: 0009-7039
Vol. 64. No. 2, 2024

An Improved Cluster Head Rotation Approach for Sensor Networks

[1]Birbal Kumar Rajak, [2]Dr. Kanika Sharma
[1]M. E. Student, [2]Assistant Professor
[1,2]Department of Electronics and Communication Engineering
[1,2]NITTTR, Sector 26, Chandigarh, India

Abstract- WSN has witnessed a steady emergence in real time healthcare applications due to its significant advantage of resource constrained sensor network. In any WSN system, balancing energy consumption and minimizing communication cost is essential especially when the WSN has a large number of sensor nodes. For large scale WSN network with thousands of sensors, communication cost overhead significantly affects the system performance as huge amounts of data needs to be sensed from all the sensors and have to be transmitted to the Base Station (BS) for processing. For a few developing and industrially fascinating applications, WSN is a promising remote innovation such as broadband home systems administration, network and neighborhood systems, facilitated arrange the executives, canny transportation frameworks. The DCHS network is the focus of this paper with a discussion of its use for the FIS technique. The technique that was proposed is the one that performs the best compared to the previous one.

Keywords— Wireless Sensor Network (WSN), Fuzzy Inference System (FIS), Packet Delivery Ratio (PDR), Dead Node, Energy

I. INTRODUCTION

An accelerated growth and evolution of sensor networks and Wireless Body Area Network (WBAN) based healthcare applications in the recent decades has considerably increased the need for higher energy efficiency in WSNs. Among the various measures employed to improve the lifespan of wirelessly operated networks, compressed sensing (CS) has emerged steadily in the recent years due to its advantages like better data compression and lower energy consumption. CS systems exploit the inherently redundant properties to improve data transmission. Numerous works published in the literature deal with the improvement of the signal reconstruction quality and energy efficiency of CS based WSN systems. In particular, all existing method intends to improve key efficiency measures like throughput rate and error rate to ensure optimal performance in outdoor channel environments. Many energy efficient clustering protocols have been introduced to attain energy efficiency, better performance metrics, Quality of Services (QoS) and better data transfer rate using limited energy available [1, 2].

An efficient WSN has to offer enhanced performance in minimising the gap that exists between key performance measures like energy consumption and highest possible data rate. In spite of intensive research to improve throughput rate and network lifetime, satisfactory performance of WSNs over large-scale network environments is still a challenging task that has to be accomplished [3].

In a WSN, each sensor node transmits signal to the base station as raw measurement without using any encoded value or frequency domain transformation. In order to achieve appropriate signal reconstruction at the receiver side, the sensor nodes have to sample the data at the Nyquist rate while formulating the measurements. In some cases, the input signal is transformed into frequency domain to represent the whole signal energy using fewer measurements or coefficients and these coefficients are enciphered and sent to the BS [4]. In an image acquisition model based on WSN network environment, the raw measurements of the pixel values are converted into Discrete Cosine Transform (DCT) space and only a small number of DCT coefficients are transmitted. By discarding major portions of the coefficients, the amount of transmitted data is greatly reduced without deteriorating the actual image quality. Based on the statistical features of the input signal (compressible or sparse), the transmission can be raw measurement or transform coefficients [5, 6].

Particularly, in WSNs an economical system for data acquisition is essential to collect and forward the collected information to the destination nodes. Unique data collection, transmission and storage techniques have to be incorporated to extend the WSN's applicability to a wide range of industrial systems. Any data compression method proposed as a solution, should meet parametric constrain like resolution, sensitivity and reliability.

Major challenges involved in WSNs are employing precise techniques, models and optimal protocol designs. These challenges can be divided as follows [7, 8]:

- Energy efficient system
- Energy efficient network clustering protocols
- Optimal path routing and data collection model

II. WSN CLUSTER APPROACH

In recent decades, 'energy efficiency' has become the new buzz word in the domain of routing and clustering.

Research and development of energy efficient real time applications has become an area of great scientific interest. With the arrival of high speed 5G networking, improvement of data rate is studied intensively in sensor node based applications used in key areas like health care, security, network security etc. Sensor nodes are smaller in size and they are equipped with limited battery capacity. They play a key role in overall network coverage and determine the lifetime of networks. Numerous studies have been undertaken on optimal data routing and collection of sensor data with the intent of maximising the network lifetime over a wide range of WSNs. Each sensor node consumes considerable amount of energy during data transmission and reception. The total energy consumption for each data packet depends on the distance the data has to be sent and the frequency of the sensor nodes used for collecting the sent data [9].

Energy efficiency using CS based models are applicable and effective only in small-scale WSNs. For large-scale WSNs, it is essential to incorporate some degree of scalability using clustering and CS based algorithms. CS based signal reconstruction models slightly enhance energy efficiency by reducing data redundancy. To further increasing energy efficiency it is essential to balance energy use with the help of appropriate cluster formations. Overall system performance can be enhanced by improving both energy overhead and energy balance using CS and clustering [10, 11].

III. DCHS

In recent decades, ‘energy efficiency’ has become the new buzz word in the domain of routing and clustering.

Research and development of energy efficient real time applications has become an area of great scientific interest. With the arrival of high speed 5G networking, improvement of data rate is studied intensively in sensor node based applications used in key areas like health care, security, network security etc. Sensor nodes are smaller in size and they are equipped with limited battery capacity. They play a key role in overall network coverage and determine the lifetime of networks. Numerous studies have been undertaken on optimal data routing and collection of sensor data with the intent of maximising the network lifetime over a wide range of WSNs. Each sensor node consumes considerable amount of energy during data transmission and reception. The total energy consumption for each data packet depends on the distance the data has to be sent and the frequency of the sensor nodes used for collecting the sent data [12].

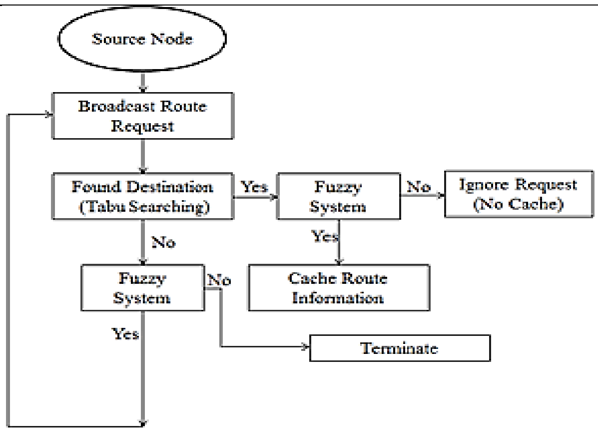

Figure 1: Flow Chart of Proposed Methodology

Algorithm CH-Selection (E, N, K, X, Y)
1. Asc - sort(E)
2. i = 1
3. **while** I ≤ N **do**
4. **if** (E_i>=E_{Avg} and i<= k) **then**
5. Eligible(i) = True
6. **else**
7. Eligible(i) = False
8. **end if**
9. i=i + 1
10. **end while**
11. **if** ($dist_i$ > distj and Eligible (i)) **then**
12. CH_i=CM_j
13. **end if**
14. **return** (CHi , CHj)

Energy efficiency using CS based models are applicable and effective only in small-scale WSNs. For large-scale WSNs, it is essential to incorporate some degree of scalability using clustering and CS based algorithms. CS based signal reconstruction models slightly enhance energy efficiency by reducing data redundancy. To further increasing energy efficiency it is essential to balance energy use with the help of appropriate cluster formations. Overall system performance can be enhanced by improving both energy overhead and energy balance using CS and clustering.

IV. FUZZY INFERENCE SYSTEM

The Fuzzy Logic Algorithm is lit up by the intense capacity of fluffy rationale framework to deal with vulnerability and uncertainty. Fluffy rationale framework is notable as model free. Their enrollment capacities are not founded on factual dispersions. In this paper, we apply fluffy rationale framework to streamline the directing procedure by some foundation. The principle objective is planning the calculation to utilize Fuzzy Logic Systems to extend the lifetime of the sensor systems.

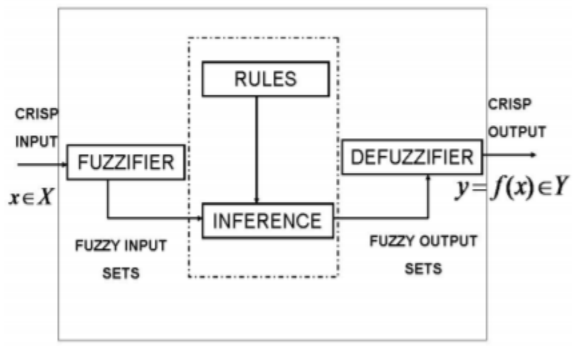

Figure 2: The structure of a fuzzy logic system

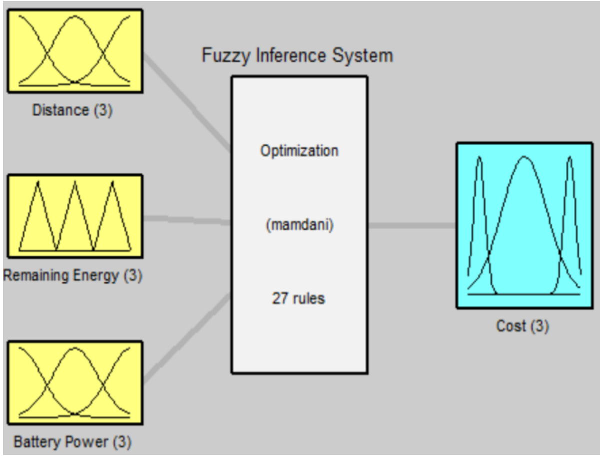

Figure 3: Optimization 27 rules with 3 inputs, 1 outputs

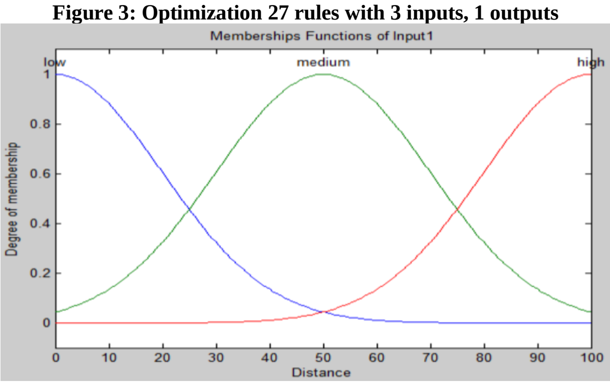

Figure 4: Members Functions of Input1

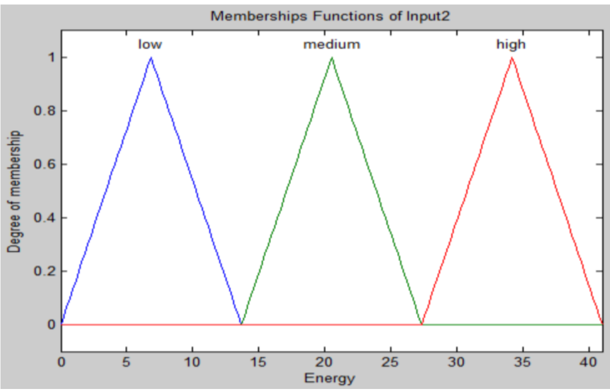

Figure 5: Members Functions of Input2

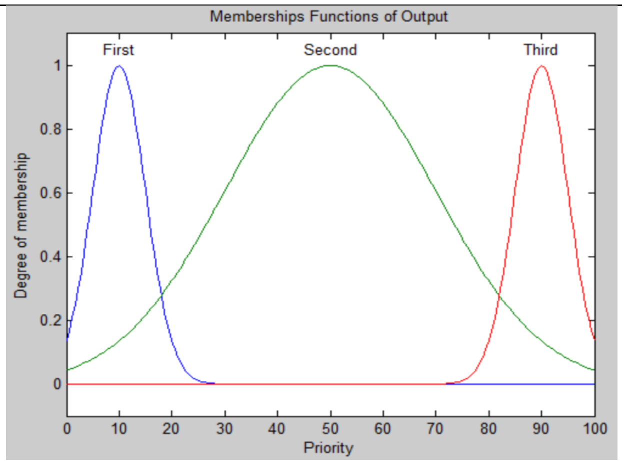

Figure 6: Members Functions of Output1

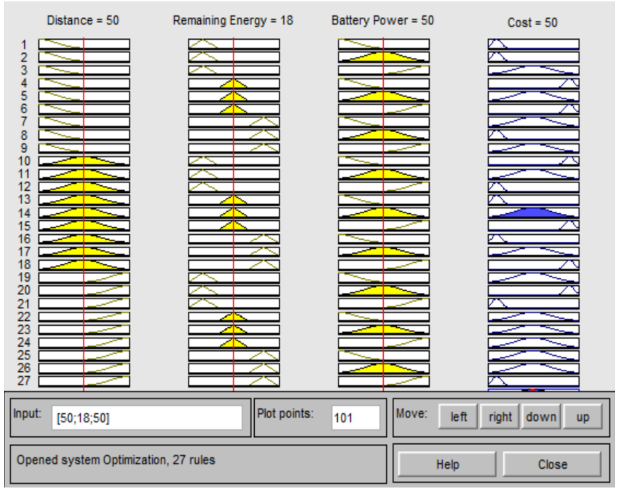

Figure 7: Rule Viewer Optimization

Entire network is divided into logical and hierarchical topology during clustering and CH uses basic aggregation operations during intra-cluster communication to minimise power consumption. Core functions involved in data transmission and the use of each sensor node in rotation helps to stabilise energy consumption in the WSN.

This work also investigates the potential metrics of mobile sink location and its associated mobility in the WSN performance. For optimal transmission of data from the CH nodes to the mobile sink path routing is formulated among different nodes. Results proved that both CS and mobile sink based data forwarding offered significant contributions to the network lifetime improvement.

V. SIMULATION RESULT

In this subsection we evaluate the performance dynamic cluster head selection using fuzzy system in terms of:

Packet delivery ratio (PDR): The proportion of successful data packets delivered to the destination compared to the total generated data packets.

As shown in table 1 the average energy consumption is obtained from the proposed DCHS using FIS. From the analysis of the results, it is found that the proposed

CINEFORUM
ISSN: 0009-7039
Vol. 64. No. 2, 2024

DSCH using FIS gives higher average energy consumption 1.89 in 160 rounds and lower average energy consumption 0.0 in 0 rounds. The proposed method is 5.5% improvement of existing rohit pachlor et al. [5]. The graphical consumption is represent in fig. 8.

Table I: Comparison Result for Average Energy Consumption (J) of the Network

Rounds	Previous LAR-CH Algorithm Avg. energy (J)	Proposed DCHS Algorithm Avg. energy (J)
0	0.0	0.0
10	0.22	0.20
20	0.48	0.39
30	0.74	0.59
40	1.00	0.77
50	1.23	0.96
60	1.42	1.16
70	1.53	1.28
80	1.64	1.37
90	1.71	1.46
100	1.78	1.55
110	1.81	1.64
120	1.86	1.69
130	1.89	1.74
140	1.93	1.79
150	1.97	1.83
160	2.00	1.89

Figure 8 shows the graphical illustration of the performance of different rounds discussed in this research work in term of average energy consumption. From the above graphical representation it can be inferred that the proposed dynamic cluster head using fuzzy interference system gives the best performance for rounds 160.

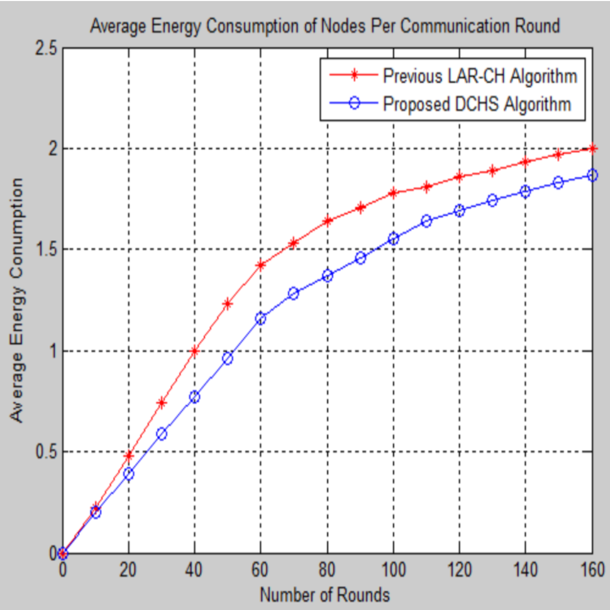

Figure 8: Average energy consumption of nodes per communication round

As shown in table II the average number of packet is obtained from the proposed dynamic cluster head using fuzzy interference system. From the analysis of the results, it is found that the proposed dynamic cluster head using fuzzy interference system gives higher average number of packet 350000 in 140 rounds and lower average number of packet 0.0 in 0 rounds.

Table II: Comparison Result for Number of Packet Received to the Base Station

Rounds	Previous LAR-CH Algorithm Packets Received	Proposed DCHS Algorithm Packets Received
0	0	0
10	20000	30000
20	50000	70000
30	80000	10500
40	110000	135000
50	150000	175000
60	190000	215000
70	230000	260000
80	260000	290000
90	280000	305000
100	290000	320000
110	300000	330000
120	310000	340000
130	315000	345000
140	320000	350000

Figure 9 shows the graphical illustration of the performance of different rounds discussed in this research work in term of average packet received.

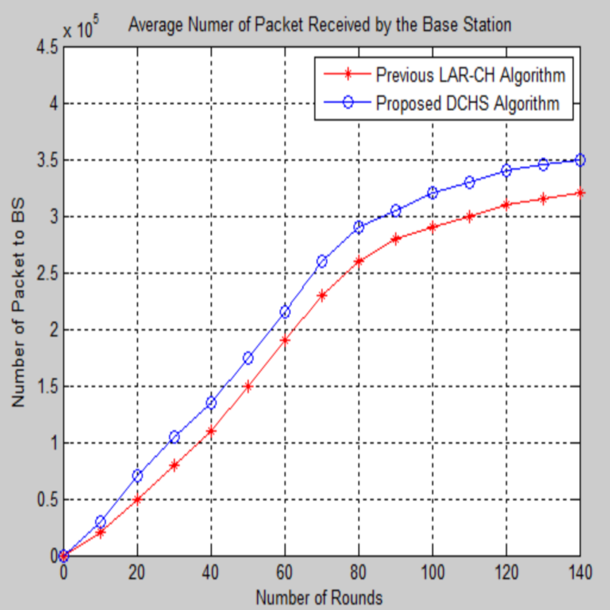

Figure 9: Average number of packet received to the base station

From the above graphical representation it can be inferred that the proposed dynamic cluster head using fuzzy interference system gives the best performance for rounds 140.

VI. CONCLUSION

Energy efficient WSN clustering concepts, potential applications of DCHS based data transmission in WSN network, various methodologies used to accomplish mobile sink based data forwarding and all other possible sensor data computations that explored the energy related issues to be focused on, related to the high performance WSN network.

REFERENCES

[1] Rachna Sharma and Bhargavi Deshpande, "An Efficient Hybrid Routing Scheme with LEACH Protocol for the Enhancement of Lifetime of the Network in WSN", 4th Annual Flagship India Council International Subsections Conference (INDISCON, IEEE 2023.

[2] Yanhong Jing, Lan Shen, Chunlong Yao and Chengxi Gao, "A Clustered Routing Protocol for Ensuring Structural Stability of Clusters in WSN", 4th International Conference on Big Data, Artificial Intelligence and Internet of Things Engineering (ICBAIE), IEEE 2023.

[3] Yogesh Patidar, Manish Jain and Ajay Kumar Vyas, "Comparative Analysis of Clustering and Routing Protocols for Energy-Efficient WSN", 4th International Conference on Advances in Computing, Communication Control and Networking (ICAC3N), IEEE 2022.

[4] Amar Jukuntla and Dr. Venkatesulu Dondeti, "Energy Efficiency Scheme For Wireless Sensor Network With Rendezvous Nodes And Mobile Link", 7th International Conference of Computing Engineering and Design (ICCED), IEEE 2021.

[5] Rohit Pachlor and Deepti Shrimankar, "LAR-CH: A Cluster-Head Rotation Approach for Sensor networks", IEEE Sensors Journal, Volume 18, Issue 23, PP. No. 01-08, Dec.1, 2018.

[6] M. Bheemalingaiah and M. M. Naidu, "Performance Analysis of Power -aware Node-disjoint Multipath Source Routing in Mobile Ad Hoc Networks", IEEE 7th International Advance Computing Conference, PP. No. 361-371, IEEE 2017.

[7] Dogan Yildiz, SerapKaragol and Okan Ozgonenel, "A Hyperbolic Location Algorithm for Various Distributions of a Wireless Sensor Networks", Smart Grid and Cities Congress and Fair (ICSG), 5th International Istanbul, PP. No. 451-459, IEEE 2016.

[8] Alexandros Ladas, Nikolaos Pavlatos, Nuwan Weerasinghe and Christos Politis, "Multipath Routing Approach to Enhance Resiliency and Scalability in Ad-hoc Networks", Ad-hoc and Sensor Networking Symposium, PP. No. 01-06, IEEE 2016.

[9] Pengwu Wan, BenjianHao, Zan Li, Licun Zhou, Mian Zhang, "Time differences of arrival estimation of mixed interference signals using blind source separation based on wireless sensor networks", IET Signal Processing, vol.10, issue 8, pp.924-929, 2016.

[10] Mohammadi K., Alavi O., Mostafaeipour A., Goudarzi N. And Jalilv and M., "Assessing different parameters estimation methods ofWeibull distribution to compute wind power density", ELSE VIER Energy Conversion and Management Journal, Vol.108, pp. 322-335, 2016.

[11] Miriam Carlos-Mancilla, Ernesto López-Mellado, and Mario Siller, "Wireless Sensor Networks Formation: Approaches and Techniques," Journal of Sensors, vol. 2016, Article ID 2081902, 18pages, 2016.

[12] Park S. Y. and Lee J. J., "Stochastic Opposition-Based Learning Usinga Beta Distribution in Differential Evolution", IEEE Transactions On Cybernetics, vol. 46, Number 10, pp.2184-2194, October 2016.

[13] Osama Ennasr, Guoliang Xing and Xiaobo Tan, " Distributed Time-Difference-of-Arrival (TDOA)-based Localization of a Moving Target", in Proc. IEEE 55th Conference on Decision and Control (CDC), pp. 2652-2658, IEEE 2016.

[14] Santar Pal Singh, S.C. Sharma, "Range-Free Localization Techniques in Wireless Sensor Networks: A Review", in Proc. 3rd International Conference on Recent Trends in Computing 2015 (ICRTC-2015), vol.57, pp. 7 – 16, 2015.

[15] Yildiz D., Karagol S., Ozgonenel O., Tadiparthi S., Bikdash M., "A Novel Self Localization Approach for Sensors", Sensor Signal Processing for Defense (SSPD), Edinburgh, Scotland, 2015.